Trade Math
Annotated Instructor’s Guide

Module Overview
This module introduces the mathematical operations commonly used in construction, and explains how geometry is used in the trade. Trainees will learn how to add, subtract, multiply, and divide whole numbers, fractions, and decimals, as well as how to convert decimals, fractions, and percentages.

Prerequisites
Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: Core Curriculum and Ironworking Level One.

Objectives
Upon completion of this module, the trainee will be able to do the following:
1. Perform calculations using fractions.
2. Perform calculations using decimals and percentages.
3. Convert between fractions of a foot and decimals of a foot.
4. Calculate the areas of selected items.
5. Solve problems for right triangles.
6. Calculate the volumes of selected items.
7. Calculate the weights of selected items.
8. Solve problems for unknown quantities.

Performance Tasks
This is a knowledge-based module. There are no performance tasks.

Materials and Equipment
Multimedia projector and screen
Ironworking Level Two
    PowerPoint® Presentation Slides
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Copies of your local code
Sample work orders that require mathematical functions
Calculator
Standard ruler (with 1/16-inch markings)
Folding ruler
Tape measure
Clay
Several empty vessels of various shapes
Sand or water to fill vessels
Measuring cup
Quick Quizzes*
Module Examinations**

* Located at the back of this module.
**Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Additional Resources
This module presents thorough resources for task training. The following resource material is suggested for further study.

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 25 hours are suggested to cover *Trade Math*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

### Topic

#### Sessions I through III. Introduction; Math Review

A. Introduction

B. Math Review
   1. Working with Whole Numbers
   2. Adding and Subtracting Whole Numbers; Practice Exercises
   3. Multiplying and Dividing Whole Numbers; Practice Exercises
   4. Working with Common Fractions
   5. Reducing Common Fractions; Practice Exercises
   6. Finding Common Denominators; Practice Exercises
   7. Adding and Subtracting Common Fractions; Practice Exercises
   8. Multiplying and Dividing Common Fractions; Practice Exercises
   9. Working with Decimal Fractions; Practice Exercises
   10. Converting Decimal Fractions to Common Fractions; Practice Exercises
   11. Converting Common Fractions to Decimal Fractions; Practice Exercises
   12. Adding and Subtracting Decimal Fractions; Practice Exercises
   13. Multiplying and Dividing Decimal Fractions; Practice Exercises
   14. Percentages; Practice Exercises
   15. Tolerances; Practice Exercises
   16. Squares and Square Roots

#### Sessions IV and V. Linear Measure; Equations; Formulas

A. Linear Measure; Practice Exercises

B. Equations

C. Formulas
   1. Surface Area
   2. Rectangles and Squares; Practice Exercises
   3. Triangles; Practice Exercises
   4. Circles; Practice Exercises
   5. Volume
   6. Cubes and Rectangular Objects
   7. Cylinders; Practice Exercises

#### Sessions VI and VII. Right Triangles; Weight; Solving for Unknowns

A. Right Triangles
   1. 3-4-5 Rule Practice Exercises

B. Weight
   1. Weight of Steel Bar
   2. Weight of Steel Plate
   3. Weight of Steel Tank

C. Solving for Unknowns; Practice Exercises
Sessions VIII and IX. Weight Calculations: Practical Application

A. Weight Calculations
   1. Steel Plate; Practice Exercises
   2. Steel Tanks; Practice Exercises
   3. Shapes; Practice Exercises
   4. Circular Plate; Practice Exercises
   5. Cylinders; Practice Exercises

B. Structural Steel Member Weight Calculations; Practice Exercises

Session X. Review and Testing

A. Review

B. Module Examination
   1. Trainees must score 70% or higher to receive recognition from NCCER.
   2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.
Module Overview
This module teaches the importance of quality workmanship and covers how to find, identify, and avoid weld imperfections while adhering to necessary codes and specifications.

Prerequisites
Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: Core Curriculum and Welding Level One, Modules 29101-09 through 29105-09.

Objectives
Upon completion of this module, the trainee will be able to do the following:
1. Identify and explain codes governing welding.
2. Identify and explain weld imperfections and their causes.
3. Identify and explain nondestructive examination practices.
4. Identify and explain welder qualification tests.
5. Explain the importance of quality workmanship.
6. Identify common destructive testing methods.
7. Perform a visual inspection of fillet welds.

Performance Tasks
There are no performance tasks for this module.

Materials and Equipment List
Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Welding 1 PowerPoint® Presentation Slides
Multimedia projector and screen
Desktop or laptop computer
Appropriate personal protective equipment
Welding samples showing:
- Porosity
- Inclusions
- Cracks
- Weld metal cracks
- Base metal cracks
- Incomplete joint penetration
- Incomplete fusion
- Undercut
- Arc strikes
- Spatter
- Unacceptable weld profiles
Undercut gauge
Butt weld reinforcement gauge
Fillet weld blade gauge set
Welding coupon examples
Samples of ASME, AWS, API, and ANSI welding codes
Photos of damage to equipment and structures caused by failed welds
Examples of Welding Procedure Specifications and Procedure Qualification Records
Liquid penetrant test kit
Radiograph examples
Tested specimens of good and failed welds
Module Examinations*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.
Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment. Review general safety guidelines associated with welding and refer to the MSDS for liquid penetrant solvent.

Additional Resources

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.

OSHA Standard 1926.351, Arc Welding and Cutting.

Teaching Time for this Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover Weld Quality. You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
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<tbody>
<tr>
<td><strong>Session I. Introduction; Codes; Weld Discontinuities</strong></td>
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<tr>
<td>A. Introduction</td>
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<tr>
<td>B. Codes Governing Welding</td>
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<tr>
<td>1. American Society of Mechanical Engineers</td>
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<td>2. American Welding Society</td>
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<td>3. American Petroleum Institute</td>
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<td>4. American National Standards Institute</td>
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<tr>
<td>5. Marine Codes</td>
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<td>C. Basic Elements of Welding Codes</td>
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<tr>
<td>1. Welding Procedure Qualification</td>
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<td>2. Welder Performance Qualification</td>
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<td>3. Welder Operator Qualification</td>
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<td>D. Weld Discontinuities and Their Causes</td>
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<td>1. Porosity</td>
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<td>2. Inclusions</td>
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<td>3. Cracks</td>
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<td>4. Incomplete Joint Penetration</td>
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<td>5. Incomplete Fusion</td>
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<td>6. Undercut</td>
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<td>7. Arc Strikes</td>
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<td>8. Spatter</td>
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<tr>
<td>9. Acceptable and Unacceptable Weld Profiles</td>
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Session II. Nondestructive Examination (NDE) Practices
   A. Visual Inspection
   B. Liquid Penetrant Inspection
   C. Magnetic Particle Inspection
   D. Radiographic Inspection
   E. Ultrasonic Inspection
   F. Electromagnetic (Eddy Current) Inspection
   G. Leak Testing

Session III. Destructive Testing; Welder Performance Qualification Tests
   A. Destructive Testing
   B. Welder Performance Qualification Tests
      1. Welding Positions Qualification
      2. AWS Structural Steel Code
      3. ASME Code
      4. Welder Qualification Tests

Session IV. Quality Workmanship; Review and Testing
   A. Quality Workmanship
      1. Typical Site Organization
      2. Chain of Command
   B. Module Review
   C. Module Examination
      1. Trainees must score 70% or higher to receive recognition from the NCCER.
      2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.
Position Arc Welding
Annotated Instructor’s Guide

Module Overview
This module introduces weld joints and positions used in metal structures. It explains how to prepare welding equipment and make V-groove joints and welds.

Prerequisites
Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; Ironworking Level One; and Ironworking Level Two, Module 30201-11.

Objectives
Upon completion of this module, the trainee will be able to do the following:

1. Identify and explain weld joints and positions.
2. Prepare arc welding equipment.
3. Identify and explain V-groove joints and welds.
4. Perform shielded metal arc welding (SMAW) on V-groove joints with backing and open-root V-groove joints in the following positions:
   - Flat (1G)
   - Horizontal (2G)
   - Vertical (3G)
   - Overhead (4G)

Performance Tasks
Under the supervision of the instructor, the trainee should be able to do the following:

1. Prepare arc welding equipment.
2. Perform shielded metal arc welding (SMAW) on V-groove joints with backing and open-root V-groove joints in the following positions:
   - Flat (1G)
   - Horizontal (2G)
   - Vertical (3G)
   - Overhead (4G)

Materials and Equipment

<table>
<thead>
<tr>
<th>Multimedia projector and screen</th>
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<tbody>
<tr>
<td>Computer</td>
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<tr>
<td>Whiteboard/chalkboard</td>
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<tr>
<td>Markers/chalk</td>
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<tr>
<td>Pencils and scratch paper</td>
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<tr>
<td>Appropriate personal protective equipment</td>
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<tr>
<td>Examples of fillet and groove welds</td>
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<td>SMAW machine</td>
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<tr>
<td>Welding bench with arm for position work</td>
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<tr>
<td>Welding shop tools and safety equipment</td>
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<tr>
<td>Several angle finders</td>
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</tbody>
</table>

| Sufficient coupons for ten trainee sessions |
| Two pieces of \( \frac{3}{8}'' \times 3'' \times 7'' \) and one piece of \( \frac{1}{4}'' \times 1'' \times 8'' \) carbon steel for each trainee per session |
| Sufficient \( \frac{1}{2}'' \), \( \frac{3}{8}'' \), or \( \frac{5}{8}'' \) E7018 electrodes |
| Examples of acceptable and unacceptable groove weld profiles |
| Example of surface welding on an inclined vertical surface |
| Examples of open-root groove angles on plate and pipe |
| Module Examinations* |
| Performance Profile Sheets* |

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.
Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working with and around welding equipment. Emphasize the importance of proper housekeeping.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.


Lincoln Electric website: www.lincolnelectric.com offers sources for products and training.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 20 hours are suggested to cover *Position Arc Welding*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
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<tbody>
<tr>
<td>Sessions I and II. Introduction; Welding Positions; Preparing Equipment</td>
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<tr>
<td>A. Introduction</td>
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<tr>
<td>B. Weld Positions and Joints</td>
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<tr>
<td>1. Weld Positions</td>
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<tr>
<td>2. Types of Joints</td>
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<tr>
<td>3. Types of Welds</td>
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<tr>
<td>4. Welding Position</td>
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<tr>
<td>5. Codes and Welding Procedure Specifications</td>
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<td>6. Welding Joint Preparation</td>
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<tr>
<td>C. Welding Equipment Setup</td>
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<tr>
<td>1. Preparing the Welding Area</td>
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<tr>
<td>2. Preparing the Weld Coupons for V-Groove Welds with Backing</td>
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<tr>
<td>a. Laboratory</td>
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<tr>
<td>Have trainees practice preparing a weld coupon and tack-welding it.</td>
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<tr>
<td>3. Electrodes</td>
<td></td>
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<tr>
<td>4. Preparing the Welding Machine</td>
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<tr>
<td>D. PT/Laboratory</td>
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<tr>
<td>Have trainees prepare arc welding equipment. This laboratory corresponds to Performance Task 1.</td>
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</tbody>
</table>
Sessions III through VII. V-Groove Welds; SMAW of V-Groove Welds with Backing; Open-Root V-Groove Welds; SMAW of Open-Root V-Groove Welds

A. V-Groove Welds with Backing

B. SMAW of V-Groove Welds with Backing
   1. Practicing Flat V-Groove Welds with Backing (1G Position)
      a. Laboratory
         Have trainees practice making flat V-groove welds with backing (1G Position)
   2. Horizontal Welds (2G Position)
      a. Laboratory
         Have trainees practice running beads and making horizontal V-groove welds with backing (2G Position)
   3. Vertical Welds (3G Position)
      a. Laboratory
         Have trainees practice running beads and making vertical V-groove welds with backing (3G Position)
   4. Overhead Welds (4G Position)
      a. Laboratory
         Have trainees practice running overhead beads and making overhead V-groove welds with backing (4G Position)

C. Open-Root V-Groove Welds
   1. Prepare the Welding Coupons for Open-Root V-Groove Welds
   2. Electrodes
   3. Root Pass
   4. Acceptable and Unacceptable Groove Weld Profiles

D. SMAW of Open-Root V-Groove Welds
   1. Practicing Flat Open-Root V-Groove Welds (1G Position)
      a. Laboratory
         Have trainees practice making Flat open-root V-groove welds (1G Position)
   2. Horizontal Welds (2G Position)
      a. Laboratory
         Have trainees practice making horizontal open-root V-groove welds (2G Position)
   3. Vertical Welds (3G Position)
      a. Laboratory
         Have trainees practice running vertical beads and making vertical open-root V-groove welds (3G Position)
   4. Overhead Welds (4G Position)
      a. Laboratory
         Have trainees practice running overhead beads and making overhead open-root V-groove welds (4G Position)
E. PT/Laboratory

Have trainees perform shielded metal arc welding (SMAW) on V-groove joints with backing and open-root V-groove joints in the following positions:

- Flat (1G)
- Horizontal (2G)
- Vertical (3G)
- Overhead (4G)

This laboratory corresponds to Performance Task 2.

Session VIII. Review and Testing

A. Review

B. Module Examination

1. Trainees must score 70% or higher to receive recognition from NCCER.
2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing

1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.
Module Overview

This module introduces the types and configurations of forklifts, their operation, and how to inspect and maintain them.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: Core Curriculum; Ironworking Level One; and Ironworking Level Two, Modules 30201-11, 29106-09, and 30202-11.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Describe the uses of a forklift.
2. Identify the components and controls on a typical forklift.
3. Describe the attachments used on forklifts.
4. Explain safety rules and qualifications for operating a forklift.
5. Explain how to perform prestart inspection and maintenance procedures.
6. Explain how to operate and use a forklift:
   • Start, warm up, and shut down a forklift
   • Perform basic maneuvers with a forklift
   • Interpret forklift load charts
   • Perform basic lifting operations with a forklift
7. Interpret and demonstrate the proper hand and verbal signals for forklift operations.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:

1. Perform prestart inspection and maintenance procedures.
2. Start, warm up, and shut down a forklift.
3. Perform basic maneuvers with a forklift.
4. Interpret forklift load charts.
5. Perform basic lifting operations with a forklift.
6. Perform the proper hand and verbal signals for forklift operations.

Materials and Equipment

Multimedia projector and screen
Ironworking Level Two
PowerPoint® Presentation Slides
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Access to multiple forklifts and telehandlers
Access to multiple attachments for forklift forks
Operator manuals and load charts for any available forklifts and telehandlers
Operator’s manual with a service hours schedule
Suitable area for forklift practice and work
Miscellaneous loads for forklift practice
Module Examinations*
Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.
**Safety Considerations**

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working on or operating forklifts. Emphasize the importance of proper housekeeping.

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**Additional Resources**

This module presents thorough resources for task training. The following resource material is suggested for further study.


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**Teaching Time for This Module**

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 17½ hours are suggested to cover *Forklifts*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
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<tbody>
<tr>
<td>Sessions I and II. Introduction; Identification of Equipment Components and Controls; Safety Guidelines; Basic Preventive Maintenance; Basic Operation</td>
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<tr>
<td>A. Introduction</td>
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<tr>
<td>1. Types of Forklifts</td>
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<td>2. Forklift Uses</td>
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<tr>
<td>B. Identification of Equipment Components and Controls</td>
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<tr>
<td>1. Operator’s Cab</td>
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<td>2. Instruments</td>
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<td>3. Controls</td>
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<td>4. Operator Comfort and Other Controls</td>
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<tr>
<td>5. Forklift Attachments</td>
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<tr>
<td>C. Safety Guidelines</td>
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<tr>
<td>1. Operator Training and Certification</td>
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<td>2. Operator Safety</td>
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<td>3. Safety of Co-Workers and the Public</td>
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<tr>
<td>4. Equipment Safety</td>
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<td>5. Spill Containment and Cleanup</td>
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<td>6. Hand Signals Used with Forklifts</td>
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<td>D. Basic Preventive Maintenance</td>
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<tr>
<td>1. Daily Inspection Checks</td>
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<td>2. Servicing a Forklift</td>
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<td>3. Preventive Maintenance Records</td>
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<td>E. Basic Operation</td>
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<tr>
<td>1. Load Charts</td>
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<td>2. Suggestions for Effective Forklift Operation</td>
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<tr>
<td>3. Preparing to Work</td>
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<td>4. Basic Maneuvering</td>
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</table>
Sessions III through VI. Work Activities

A. Work Activities
   1. Basic Operation Movement
   2. Using Special Attachments
   3. Transporting the Forklift

B. PT/Laboratories
   1. Have trainees perform prestart inspection and maintenance procedures. This laboratory corresponds to Performance Task 1.
   2. Have trainees start, warm up, and shut down a forklift. This laboratory corresponds to Performance Task 2.
   3. Have trainees perform basic maneuvers with a forklift. This laboratory corresponds to Performance Task 3.
   4. Have trainees interpret forklift load charts. This laboratory corresponds to Performance Task 4.
   5. Have trainees perform basic lifting operations with a forklift. This laboratory corresponds to Performance Task 5.
   6. Have trainees perform the proper hand and verbal signals for forklift operations. This laboratory corresponds to Performance Task 6.

Session VII. Review and Testing

A. Review

B. Module Examination
   1. Trainees must score 70% or higher to receive recognition from NCCER.
   2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing
   1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
   2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.
Module Overview

This module introduces the trainee to the typical information found on computer-aided design (CAD) drawings.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: Core Curriculum; Ironworking Level One; and Ironworking Level Two, Modules 30201-11, 29106-09, 30202-11, and 30203-11.

Objectives

Upon completion of this module, the trainee will be able to do the following:
1. Name the types of structural plans, and identify the information included on each.
2. Describe the purpose and relationship of the different types of drawings.
3. Read and interpret the symbols and abbreviations on erection plans and drawings.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:
1. Name the types of structural plans, and identify the information included on each.
2. Given a set of drawings, locate information as specified by the instructor.
3. Read and interpret the symbols and abbreviations on erection plans and drawings.

Materials and Equipment

Multimedia projector and screen
Ironworking Level Two
PowerPoint® Presentation Slides
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Miscellaneous pictures of numbered pieces and a related erection drawing

Miscellaneous examples of drawings and plans, including:
Architectural drawings
Structural drawings/plans
Elevation drawings
Framing plans
Foundation plans (shallow, intermediate, and deep)
Erection drawings
Shop drawings
Fabrication drawings
Ornamental erection drawings
Module Examinations*
Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.
Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working around construction sites and structural iron. Emphasize the importance of proper housekeeping.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.


Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover Trade Drawings Two. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

<table>
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<tr>
<th>Topic</th>
<th>Planned Time</th>
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<tbody>
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<td><strong>Session I. Introduction; Plans and Drawings, Part One</strong></td>
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<tr>
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<td>1. Other Uses for Erection Drawings</td>
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<td>3. Sections and Details</td>
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<td>4. Ornamental Erection Drawings</td>
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<td>5. Shop Fabrication Drawings</td>
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<td>B. Reinforcing Drawings</td>
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<td>C. General Notes</td>
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<td>D. PT/Laboratory</td>
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<tr>
<td>1. Have trainees name the types of structural plans, and identify the information included on each. This laboratory corresponds to Performance Task 1.</td>
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<tr>
<td>2. Given a set of drawings, have trainees locate information as specified by the instructor. This laboratory corresponds to Performance Task 2.</td>
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<tr>
<td>3. Have trainees read and interpret the symbols and abbreviations on erection plans and drawings. This laboratory corresponds to Performance Task 3.</td>
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</tr>
</tbody>
</table>
Session IV. Review and Testing

A. Review

B. Module Examination
   1. Trainees must score 70% or higher to receive recognition from NCCER.
   2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing
   1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
   2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.
Module Overview

This module provides an overview of personnel lifting and lift planning, and introduces crane load charts and load balancing. It explains how the center of gravity is calculated and affects the lift. It also covers sling selection, and explains the uses of jacks, tuggers, hoists, skids, and rollers.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed Basic Rigger.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Describe the basic requirements to lift personnel.
2. Explain how a sling stress is determined.
3. Describe the basic elements of a lift plan.
4. Explain the purpose of a load chart.
5. Calculate and explain how the center of gravity is determined.
6. Given a particular load, select the appropriate sling(s) for a lift.
7. Describe how jacks, hoists, skids, and rollers are used to move load laterally.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:

1. Calculate the center of gravity of a load.
2. Given a particular load, select the appropriate sling(s) for a lift.

Materials and Equipment

Multimedia projector and screen
Basic Rigger / Intermediate Rigger / Advanced Rigger PowerPoint® Presentation Slides
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
OSHA regulations on lifting personnel
OSHA guidance on personnel platforms:
   Crane or Derrick Suspended Personnel Platforms
Various types of slings and hitches
Sample lift plan

Manufacturer’s literature for different types of cranes
Sample load charts
ASME B30.5
ANSI/SAE J987
Teeter-totter and weights
Several jacks
Grip hoist
Tuggers
Rollers
Skids
Copies of the Quick Quiz*
Module Examinations**
Performance Profile Sheets**

* Located in the back of this module.
**Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.
Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires trainees to work with hand tools and slings. Ensure that trainees are briefed on shop safety policies and hand tool safety.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.


Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover Intermediate Rigging. You will need to adjust the time required for testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

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<td>4. Choker Hitches</td>
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<td>Have trainees practice selecting the appropriate sling(s) for a lift. This laboratory corresponds to Performance Task 2.</td>
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<td>4. Truck-Mounted Telescopic Crane</td>
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<td>C. Crane Load Charts</td>
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<td>2. Operating Conditions</td>
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</table>
Session III. Load Balancing; Special Equipment Used for Lateral Movement of Loads

A. Load Balancing
   1. Center of Gravity
   2. Center of Gravity and Leverage

B. Laboratory
   Have trainees practice calculating the center of gravity of a load. This laboratory corresponds to Performance Task 1.

C. Special Equipment Used for Lateral Movement of Loads
   1. Jacking
   2. Grip Hoists
   3. Skids
   4. Rollers

Session IV. Review and Testing

A. Review

B. Module Examination
   1. Trainees must score 70 percent or higher to receive recognition from NCCER.
   2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.

C. Performance Testing
   1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
   2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.
Module Overview

This module introduces the trainee to the codes and procedures involved in erecting structural steel.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; Ironworking Level One; and Ironworking Level Two, Module 30201-11, Module 29106-09, Modules 30202-11 through 30204-11, and Module 38201-10.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Explain and demonstrate pre-erection activities for structural steel.
2. Explain and demonstrate erecting bearing devices.
3. Explain and demonstrate erecting columns.
4. Explain and demonstrate erecting horizontal members.
5. Explain and demonstrate erecting bracing and bridging.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:

1. Demonstrate pre-erection activities for structural steel.
2. Demonstrate erecting bearing devices.
3. Demonstrate erecting columns.
4. Demonstrate erecting horizontal members.
5. Demonstrate erecting bracing and bridging.

Materials and Equipment

Multimedia projector and screen
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Sample project drawings, including general information drawing
Current copies of the following manuals:
AISC Manual of Steel Construction
AISC Code of Standard Practice for Steel Buildings and Bridges
AISC Manual of Steel Construction – Allowable Stress Design
Standard Specifications for Highway Bridges of American Association of State Highway and Transportation Officials (AASHTO)
n Specifications for Steel Railway Bridges of the American Railway Engineering and Maintenance of Way Association (AREMA)
Structural Welding Code of American Welding Society (AWS)
Job site or training area where structural members and erection equipment is set up with appropriate drawings for the site
Job site or training area prepared for erecting structural steel members
Examples of pick lists
A supply of structural steel components (bearing devices, columns, beams, girders, joists, shear connections, bracing and bridging material, and fasteners)
Tools needed to erect and secure structural steel components
Examples of good and bad anchor bolts
Module Examinations*
Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.
**Safety Considerations**

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working with structural iron. Emphasize the importance of proper housekeeping.

**Additional Resources**

This module presents thorough resources for task training. The following resource material is suggested for further study.


**Teaching Time for This Module**

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 30 hours are suggested to cover *Structural Ironworking Two*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

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<td>B. Pre-Erection Activities for Structural Steel</td>
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<td>2. Verifying Site Readiness</td>
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<td>3. Planning Jobs</td>
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<td>4. Unloading, Inspecting, and Preparing Structural Materials</td>
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<td>5. Inspecting and Preparing Foundations</td>
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<td>6. Inspecting and Preparing Bearing Devices</td>
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<td>7. Inspecting Grouting</td>
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<td>8. Reviewing Field Connection Materials</td>
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<td>9. Reviewing Temporary Supports for Structural Steel Frames</td>
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<td>10. Building Trusses and Bents</td>
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<td>11. Reviewing Bracing and Bridging Requirements</td>
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<td>12. Reviewing Tolerances</td>
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<td><strong>C. Laboratory</strong></td>
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<tr>
<td>Have trainees demonstrate pre-erection activities for structural steel.</td>
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<tr>
<td>This laboratory corresponds to Performance Task 1.</td>
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</tbody>
</table>
Sessions IV–XI. Erecting (Setting) Bearing Devices; Erecting Columns; Erecting Horizontal Members; Erecting Bracing and Bridging

A. Erecting (Setting) Bearing Devices
   1. Preparing Bearing Devices for Erection
   2. Positioning and Securing Bearing Devices

B. Erecting Columns
   1. Preparing Erection of Columns
   2. Rigging Columns for Erection
   3. Positioning and Securing Columns

C. Erecting Horizontal Members
   1. Relationships of Beams, Girders, and Joists
   2. Bearing and Shear Connections
   3. Preparing Erection of Horizontal Members
   4. Rigging Horizontal Members for Erection
   5. Positioning and Securing Horizontal Members

D. Erecting Bracing and Bridging
   1. Preparing Erection of Bracing and Bridging
   2. Rigging Bracing and Bridging Components for Erection
   3. Positioning and Securing Bracing and Bridging Components

E. Performance Tasks/Laboratory
   1. Have trainees demonstrate erecting bearing devices. This laboratory corresponds to Performance Task 2.
   2. Have trainees demonstrate erecting columns. This laboratory corresponds to Performance Task 3.
   3. Have trainees demonstrate erecting horizontal members. This laboratory corresponds to Performance Task 4.
   4. Have trainees demonstrate erecting bracing and bridging. This laboratory corresponds to Performance Task 5.

Session XII. Review and Testing

A. Review

B. Module Examination
   1. Trainees must score 70% or higher to receive recognition from NCCER.
   2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing
   1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
   2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.
Module Overview

This module introduces some of the information and techniques involved in erecting steel joists and joist girders.

Prerequisites

Before you begin this module, it is recommended that you successfully complete Core Curriculum; Ironworking Level One; and Ironworking Level Two, Modules 30201-11, 29106-09, 30202-11 through 30204-11, 38201-11, and 30205-11.

Objectives

Upon completion of this module, the trainee will be able to do the following:
1. Locate and describe the information on a framing plan used by ironworkers.
2. Describe steel joist installation procedures.
3. Describe the necessary conditions and benefits of panelizing bar joists.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:
1. Interpret framing plans to determine the placement of joists and bridging.
2. Assemble, rig, and place available joists and joist girders in accordance with drawings and SJI specifications.

Materials and Equipment

- Multimedia projector and screen
- Computer
- Whiteboard/chalkboard
- Markers/chalk
- Pencils and scratch paper
- Appropriate personal protective equipment
- Current editions of the following manuals:
  - AISC Manual of Steel Construction
  - AISC Code of Standard Practice for Steel Buildings and Bridges
  - AISC Manual of Steel Construction – Allowable Stress Design
  - SJI Technical Digest No. 9 of the Steel Joist Institute (SJI)
- Job site or training area where structural members and erection equipment are set up with appropriate drawings for the site
- Job site or training area prepared for erecting structural steel members
- Examples of pick lists
- A supply of joists, joist girders, bridging material, and fasteners
- Tools needed to erect and secure joists and joist girders
- Sample project drawings, including general information drawing
- Safety Quiz*
- Module Examinations**
- Performance Profile Sheets**

* Located at the back of the module.
**Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.
**Safety Considerations**

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working with joists and girders. Emphasize the importance of proper housekeeping.

**Additional Resources**

This module presents thorough resources for task training. The following resource material is suggested for further study.

The Steel Joist Institute website: www.steeljoist.org.

**Teaching Time for This Module**

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 15 hours are suggested to cover *Steel Joists and Joist Girders*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

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<td>A. Introduction</td>
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<td>B. Framing Plan</td>
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<td>C. Receiving, Unloading, and Storage</td>
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<td><strong>Session II. Laboratory</strong></td>
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<tr>
<td>A. Laboratory</td>
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<tr>
<td>Have trainees demonstrate their understanding of the layouts from the framing plan provided by the instructor for steel joists and joist girders. This laboratory corresponds to Performance Task 1.</td>
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<tr>
<td><strong>Session III. Erecting Joist Girders; Erecting and Installing Joists</strong></td>
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<td>A. Erecting Joist Girders</td>
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<td>1. Lifting and Sorting Joist Girders</td>
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<td>2. Installing Joist Girders</td>
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<td>3. Bridging Guidelines</td>
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<td>B. Erecting and Installing Joists</td>
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<td>1. Installing Simple Joists</td>
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<td>2. Installing Panelized Joists</td>
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<td><strong>Session IV. Laboratory</strong></td>
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<tr>
<td>A. Laboratory</td>
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<tr>
<td>Have trainees demonstrate assembling, rigging, and installing joists and/or girders. This laboratory corresponds to Performance Task 2.</td>
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<tr>
<td><strong>Session V. Panels with Decking; Trusses; Safety</strong></td>
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<tr>
<td>A. Panels with Decking</td>
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<td>B. Trusses</td>
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<td>C. Safety</td>
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</table>
Session VI. Review and Testing

A. Review

B. Module Examination

1. Trainees must score 70% or higher to receive recognition from NCCER.
2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing

1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.
Module Overview

This module provides information on types of tower cranes and their components. It describes safe rigging and lifting procedures and explains the use of load charts. The use of standard hand signals is also discussed.

Prerequisites

Before you begin this module, it is recommended that the trainee shall have successfully completed Core Curriculum; Ironworking Level One; and Ironworking Level Two, Modules 30201-11, 29106-09, 30202-11 through 30204-11, 38206-10, 30205-11, and 30206-11.

Objectives

Upon completion of this module, the trainee will be able to do the following:
1. Describe the different types of tower cranes and their accessories and how each is used.
2. Define the effects of leverage as it applies to tower cranes.
3. Define the factors affecting tower crane lifting capacities.
4. Describe the four base support systems for tower cranes.
5. Describe basic tower crane safety and rigging precautions.
6. Explain site and environmental hazards associated with tower cranes.
7. Describe the various methods of communication used with tower cranes.
8. Demonstrate communication procedures using a handheld radio.
9. Demonstrate the standard tower crane hand signals as specified in ASME B30.3.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:
1. Demonstrate communication procedures using a handheld radio.
2. Demonstrate the standard tower crane hand signals as specified in ASME B30.3.

Materials and Equipment

Multimedia projector and screen
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Load rating chart
Examples of tower crane load charts

A supply of balancing devices, including:
1” × 8” × 10’ board
A concrete block
Two bricks
A sawhorse
A supply of spools and thread for reeving practice
Sufficient supply of handheld radios
Module Examinations*
Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.
Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with tower crane operation. Emphasize the importance of proper housekeeping.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.


Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2 1/2 hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 22 1/2 hours are suggested to cover Tower Cranes. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

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<tr>
<td>6. Base Support Systems</td>
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<td>E. Laboratory</td>
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<tr>
<td>1. Have trainees practice using various leverage and balance devices.</td>
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<td>2. Have trainees practice calculating rotational forces.</td>
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<td>3. Have trainees practice reeving different hoisting rope configurations.</td>
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<tr>
<td>4. Have trainees observe different tower crane base support systems firsthand.</td>
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</tbody>
</table>
Session III. Factors Affecting Lifting Capacity
   A. Factors Affecting Lifting Capacity
      1. Load Ratings
      2. Tower Height
      3. Operating Radius
      4. Wind Velocity
      5. Dynamic and Shock Loading
      6. Side Loading
      7. Critical Lifts

Session IV. General Tower Safety
   A. General Tower Safety
      1. Lifting Operations
      2. Equipment and Supervision
      3. Basic Rigging Precautions
      4. ASME Hand Signals
      5. Swing Path, Load Control, and Tag Lines
      6. Load-Handling Safety
      7. Hazardous Weather
      8. Using Cranes to Lift Personnel

Sessions V through VIII. Methods and Modes of Communication
   A. Methods and Modes of Communication
      1. Verbal Modes of Communication
      2. Laboratory
         Have trainees demonstrate verbal communication procedures using a handheld radio. This laboratory corresponds to Performance Task 1.
      3. Nonverbal Modes of Communication
      4. Laboratory
         Have trainees demonstrate the standard tower crane hand signals as specified in ASME B30.3. This laboratory corresponds to Performance Task 2.

Session IX. Review and Testing
   A. Review
   B. Module Examination
      1. Trainees must score 70% or higher to receive recognition from NCCER.
      2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.
   C. Performance Testing
      1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
      2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.
Module Overview

This module introduces the trainee to the use and care of the tools used to perform surveys and site layout activities.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; Ironworker Level One; and Ironworker Level Two, Modules 30201-11, 29106-09, 30202-11 through 30204-11, 38201-11, and 30205-11 through 30207-11.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Identify, safely use, and properly maintain the tools and equipment commonly used for site layout tasks.
2. Describe the purpose and use of survey equipment, including:
   - Builder’s level
   - Transit
   - Theodolite
   - Total station

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:

1. Set up a builder’s level.
2. Set up a theodolite.
3. Shoot elevations with a builder’s level.

Materials and Equipment

Multimedia projector and screen
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Several types of builder’s levels
   - Automatic level
   - Optical transit level
Tripod
Standard rods
Telescoping rods
Transit

Transit assemblies and parts:
   - Alidade
   - Horizontal circle
   - Leveling head
   - Transit or theodolite with optical plummet
   - Optical theodolite and tripod
   - Electronic transit
   - Electronic theodolite
   - Electronic distance measurement instrument
   - Total station
   - Global positioning satellite survey device
   - Fixed beam laser plumb bob
   - Rotating beam laser instrument
   - Auto-leveling laser instrument
   - Electronic laser beam detector
   - Module Examinations*
   - Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.
Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working with or near survey equipment and laser beams. Emphasize the importance of proper housekeeping.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.


Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover Survey Equipment Use and Care One. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
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<tbody>
<tr>
<td>Session I. Introduction; Site Layout Instruments and Equipment; Laser Instruments</td>
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<tr>
<td>A. Introduction</td>
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<tr>
<td>B. Site Layout Instruments and Equipment</td>
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<tr>
<td>1. Builder’s Level</td>
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<td>2. Automatic Leveling Instruments</td>
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<td>3. Transits</td>
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<td>4. Optical Theodolites</td>
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<td>5. Electronic Transits and Theodolites</td>
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<td>6. Electronic Distance Measurement Instruments</td>
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<td>7. Total Station</td>
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<td>8. Global Positioning Satellite Survey Devices</td>
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<td>9. Electronic Data Collection</td>
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<td>10. Care and Handling of Instruments</td>
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<td>C. Laser Instruments</td>
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<tr>
<td>1. Construction Laser Instruments</td>
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<td>2. Electronic Beam Detectors</td>
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<tr>
<td>3. Use and Selection of Construction Lasers</td>
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<td>4. Laser Instrument Safety</td>
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<td>5. Calibration and Care of Laser Instruments</td>
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Sessions II and III. Reading Transit/Theodolite Scales; Initial Setup, Adjustment, and Checkout of a Transit/Theodolite

A. Reading Transit/Theodolite Scales
   1. Reading Optical Scales and Digital Displays

B. Initial Setup, Adjustment, and Checkout of a Transit/Theodolite
   1. Setting Up Over a Point Using an Instrument with an Optical Plummet
   2. Survey Instrument Field Checks

C. Laboratory
   1. Have trainees set up a builder’s level. This laboratory corresponds to Performance Task 1.
   2. Have trainees set up a theodolite. This laboratory corresponds to Performance Task 2.
   3. Have trainees shoot elevations with a builder’s level. This laboratory corresponds to Performance Task 3.

Session IV. Review and Testing

A. Review

B. Module Examination
   1. Trainees must score 70% or higher to receive recognition from NCCER.
   2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing
   1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
   2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.